CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A structure, comprising:

    a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

    a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

2. The structure of claim 1, wherein the nanospecies is selected from a semiconductor quantum dot, a metal nanoparticle, a biomolecule, and a magnetic nanoparticle.

3. The structure of claim 2, wherein the metal nanoparticle is selected from gold nanoparticles, platinum nanoparticles, silver nanoparticles, and copper nanoparticles.

4. The structure of claim 2, wherein the biomolecule is selected from polypeptides, polynucleotides, proteins, ligands, receptors, antigens, antibodies, and discrete portions thereof.

5. The structure of claim 1, wherein the porous material is selected from a mesoporous material, a macroporous material, and a hybrid mesoporous/macroporous material.

6. The structure of claim 1, wherein the porous material is made of a material selected from a polymer, a metal, a silica material, cellulose, ceramic, zeolite, and combinations thereof.

7. The structure of claim 1, wherein the porous material is silica having a hydrocarbon-derivatized surface.

8. The structure of claim 1, wherein the first characteristic is selected from a hydrophobic characteristic, a hydrophilic characteristic, an electrostatic characteristic, a biological characteristic, a bioaffinity characteristic, a ligand-receptor characteristic, an antibody-antigen characteristic, and combinations thereof.

9. The structure of claim 1, wherein the second detectable characteristic is selected from a fluorescent characteristic, a magnetic characteristic, a luminescent characteristic, a light scattering characteristic, and a surface plasmonic characteristic.

10. The structure of claim 1, wherein the nanospecies is coated with a chemical compound, wherein the nanospecies has the first characteristic after being coated with the chemical compound.

11. The structure of claim 1, wherein the nanospecies is a hydrophobic coated semiconductor quantum dot, wherein the coating includes a hydrophobic compound substantially disposed on the semiconductor quantum dot.

12. The structure of claim 11, wherein the hydrophobic compound is selected from a $O{=}PR_3$ compound, an $O{=}PHR_2$ compound, an $O{=}PHR_1$ compound, a H_2NR compound, a HNR_2 compound, a NR_3 compound, a HSR compound, a SR_2 compound, and combinations thereof, wherein R is selected from C_1 to C_{18} hydrocarbons, and combinations thereof.

13. The structure of claim 12, wherein R is a saturated linear C_4 to C_{18} hydrocarbon.

14. The structure of claim 11, wherein the hydrophobic compound is selected from an $O{=}PR_3$ compound, a HNR_2 compound, a HSR compound, a SR_2 compound, and combinations thereof.

15. The structure of claim 11, wherein the hydrophobic compound is selected from tri-n-octylphosphine, stearic acid, and octyldecyl amine.

16. The structure of claim 11, wherein the hydrophobic compound includes tri-n-octylphosphine.

17. The structure of claim 11, wherein the hydrophobic compound includes stearic acid.

18. The structure of claim 11, wherein the hydrophobic compound includes octyldecyl amine.

19. The structure of claim 11, wherein the quantum dot comprises a core and a cap.

20. The structure of claim 11, wherein the core of the quantum dot is selected from the group consisting of IIB-VIB semiconductors, IIIB-VB semiconductors, and IVB-IVB semiconductors.

21. The structure of claim 20, wherein the core of the quantum dot is selected from the group consisting of IIB-VIB semiconductors.

22. The structure of claim 20, wherein the core of the quantum dot is CdS or CdSe.

23. The structure of claim 20, wherein the cap is selected from the group consisting of IIB-VIB semiconductors of high band gap.

24. The structure of claim 20, wherein the cap is selected from ZnS and CdS.

25. The structure of claim 1, further comprising a probe attached directly to the porous material.

26. The structure of claim 1, further comprising a probe attached indirectly to the porous material via a linking compound.

27. The structure of claim 26, where the probe is selected from a biomolecule and a biomolecule attached to a fluorophore.

28. The structure of claim 27, where the probe is selected from a biomolecule and a biomolecule attached to a fluorophore.

29. The structure of claim 1, further comprising a probe, attached to the porous material, and a fluorophore and a quenching moiety attached to the probe.

30. A method of preparing a structure, comprising:

providing a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy;

providing a porous material having the first characteristic;

introducing the nanospecies and the porous material in the presence of a solution; and

forming the structure, wherein the structure includes a porous material having a plurality of nanospecies disposed at least within the pores of the porous material, wherein the first characteristic causes the nanospecies to interact with the porous material and become disposed within the pores of the porous material.

31. The method of claim 30, wherein the nanospecies is selected from a semiconductor quantum dot, a metal nanoparticle, a biomolecule, and a magnetic nanoparticle.

32. The method of claim 31, wherein the metal nanoparticle is selected from gold nanoparticles, platinum nanoparticles, silver nanoparticles, and copper nanoparticles.

33. The method of claim 31, wherein the biomolecule is selected from polypeptides, polynucleotides, proteins, ligands, receptors, antigens, antibodies, and discrete portions thereof.

34. The method of claim 30, wherein the porous material is selected from a mesoporous material, a macroporous material, and a hybrid mesoporous/macroporous material.

35. The method of claim 30, wherein the porous material is made of a material selected from a polymer, a metal, a silica material, cellulose, ceramic, zeolite, and combinations thereof.

36. The method of claim 30, wherein the porous material is silica having a hydrocarbon-derivatized surface.

37. The method of claim 30, wherein the first characteristic is selected from a hydrophobic characteristic, a hydrophilic characteristic, an electrostatic characteristic, a biological characteristic, a bioaffinity characteristic, a ligand-receptor characteristic, an antibody-antigen characteristic, and combinations thereof.

38. The method of claim 30, wherein the second detectable characteristic is selected from a fluorescent characteristic, a magnetic characteristic, a luminescent characteristic, a light scattering characteristic, and a surface plasmonic characteristic.

39. The method of claim 30, wherein the nanospecies is coated with a chemical compound, wherein the nanospecies has the first characteristic after being coated with the chemical compound.

40. The method of claim 30, wherein the nanospecies is a hydrophobic coated semiconductor quantum dot, wherein the coating includes a hydrophobic compound substantially disposed on the semiconductor quantum dot.

41. The method of claim 30, wherein the hydrophobic compound is selected from a $O=PR_3$ compound, an $O=PHR_2$ compound, an $O=PHR_1$ compound, a H_2NR compound, a HNR_2 compound, a NR_3 compound, a HSR compound, a SR_2 compound, and combinations thereof, wherein R is selected from C_1 to C_{18} hydrocarbons, and combinations thereof.

42. The method of claim 41, wherein R is a saturated linear C_4 to C_{18} hydrocarbon.

43. The method of claim 40, wherein the hydrophobic compound is selected from a $O=PR_3$ compound, a HNR_2 compound, a HSR compound, a SR_2 compound, and combinations thereof.

44. The method of claim 40, wherein the hydrophobic compound is selected from tri-n-octylphosphine, stearic acid, and octyldecyl amine.

45. The method of claim 30, wherein the porous material includes silica beads and the nanospecieis includes coated hydrophobic semiconductor quantum dots and introducing includes mixing the silica beads and the coated hydrophobic semiconductor quantum dots in a solution of alcohol and chloroform.

46. A method of detecting at least one target, comprising:

contacting at least one structure of claim 1 with a sample, wherein the sample contains at least one target molecule, wherein each structure corresponds to only one type of target molecule, wherein when the type of target molecule is present in the sample, the structure interacts with the target molecule, and wherein each of the at least one structures has a second detectable characteristic; and

detecting at least one of the second detectable characteristics, wherein detection of each second detectable characteristic indicates that the presence of the target in the sample.

47. The method of claim 46, further comprising:

exposing the at least one structure to a first energy; and

detecting at least one second energy corresponding to the second detectable characteristic, wherein the at least one second energy is produced in response to the first energy.

48. The method of claim 46, wherein each target molecule includes a third detectable characteristic, and wherein detecting includes:

detecting at least one of the second detectable characteristics and the third detectable characteristics, wherein detection of the second detectable characteristic and the third detectable characteristic indicates the presence of the target molecule in the sample.

49. The method of claim 48, further comprising:

exposing the at least one structure to a first energy; and

detecting at least one second energy corresponding to the second detectable characteristic and a third energy corresponding to the third detectable characteristic, wherein the at least one second energy is produced in response to the first energy.

50. The method of claim 46, wherein the target molecule is a biomolecule.

51. The method of claim 50, wherein the target molecule includes a fluorophore.

52. The method of claim 46, wherein the second detectable characteristic is selected from a fluorescent characteristic, a magnetic characteristic, a luminescent characteristic, a light scattering characteristic, and a surface plasmonic characteristic.

53. A array system comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

54. A diagnostic library, comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

55. A combinatorial library, comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

56. A fluorescent ink, comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

57. A fluorescent cosmetic, comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.

58. A flow cytometry system, comprising:

a plurality of structures, including:

a nanospecies having a first characteristic and a second detectable characteristic, wherein a second detectable energy is produced corresponding to the second detectable characteristic upon exposure to a first energy; and

a porous material having the first characteristic and a plurality of pores, where the first characteristic causes the nanospecies to interact with the porous material and become disposed in the pores of the porous material.